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Understanding and evaluating catchment memory from a global hydrological model

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Every catchment has a memory defining how long a water drop may remain in this catchment and how long one given hydrological state will have repercussions on following states. Catchment memory depends partly on the storage capacity of this catchment. This storage can for example be a groundwater aquifer, a lake or reservoir, or simply snow-pack during cold seasons or throughout the year. Memory may also vary with catchment size and topography as larger catchments may see their downstream state impacted by previous upstream states over longer time periods. Given the crucial aspect of catchment memory on long-term hydrologic processes, reproducing catchment memory is one of hydrological modellers' main challenges.

Here, we investigate and assess catchment memory at global scale as modelled by the WorldWide-HYPE model, a global hydrologic model at catchment scale calibrated based on a regionalisation of elevation and land use classes. To that effect, the convergence of model runs both initialised and non-initialised is assessed over different years. Modelled catchment memory is thus computed for each catchment of the WorldWide-HYPE delineation and each month of the year. We then evaluate the modeled catchment memory in the light of observed streamflow time series in a selection of catchment. Finally, we analyze patterns in length of catchment memory and in variability over months of the year.